THE CRITERIA OF EXTENDED TENSION IN THE FRETTING PHENOMENON

Stefan Ghimişi, *Constantin Brâncuşi University of Targu Jiu*, ROMÂNIA

Abstract. Fretting is now fully identified as a small amplitude oscillatory motion which induces a harmonic tangential force between two surfaces in contact. It is related to three main loadings, i.e. fretting-wear, fretting-fatigue and fretting corrosion. More recently fretting has been discussed using the third-body concept and using the means of the velocity accommodation mechanisms introduced by Godet et al.[1], [2], [3] In this paper we approach the fretting-fatigue obtaining a quantification of cracks appearance using the tension extended criterion.

Keywords: tension, criteria, friction coefficient, fissures

1.INTRODUCTION

The complex deterioration phenomenon including, broadly speaking, two distinct processes: a process of fretting-wear which means areas deterioration with or without material detachment from the friction surfaces, and a process of fretting-fatigue which mainly involves the appearance of cracks within the friction surfaces. [4], [5] . In this paper we approach the fretting-fatigue obtaining a quantification of cracks appearance using the tension extended criterion. In the study, a sphere-plane contact is considered, subjected to a state of tension.

2. THE TENSION EXTENDED CRITERION

In order to study better the level of tension at the contact point, a series of criteria's are introduced in the specialized literature, which allows them a better appreciation of the tension level, offering predictions regarding the probability of created fissures at the contact level.

For the fragile materials, the extended tension represents an important parameter. When the friction coefficient is zero, only one main tension is extended close to the edges of the contact. This tension acts in radial direction and predicts the fissure ring. Beside the central line the extended tension acts on plane surface given by [6], [7], [8]:

$$p_b = \frac{1}{2}\left(p_{xx} + p_{yy}\right) + \frac{1}{2}\left[\left(p_{xx} - p_{yy}\right)^2 + 4p_{xy}^2\right]^{1/2} \qquad (1)$$

The direction of this tension makes with axe z an angle:

$$\theta = \frac{1}{2}\arctan\left[\frac{2p_{xy}}{\left(p_{xx} - p_{yy}\right)}\right] \qquad (2)$$

In fig.1 and 2 the dependency of the extended tension is represented p_b for different values of coefficient μ, in the interior of the charged region, $|r| \le 1$ and $|x| \le 1$. [9], [10].

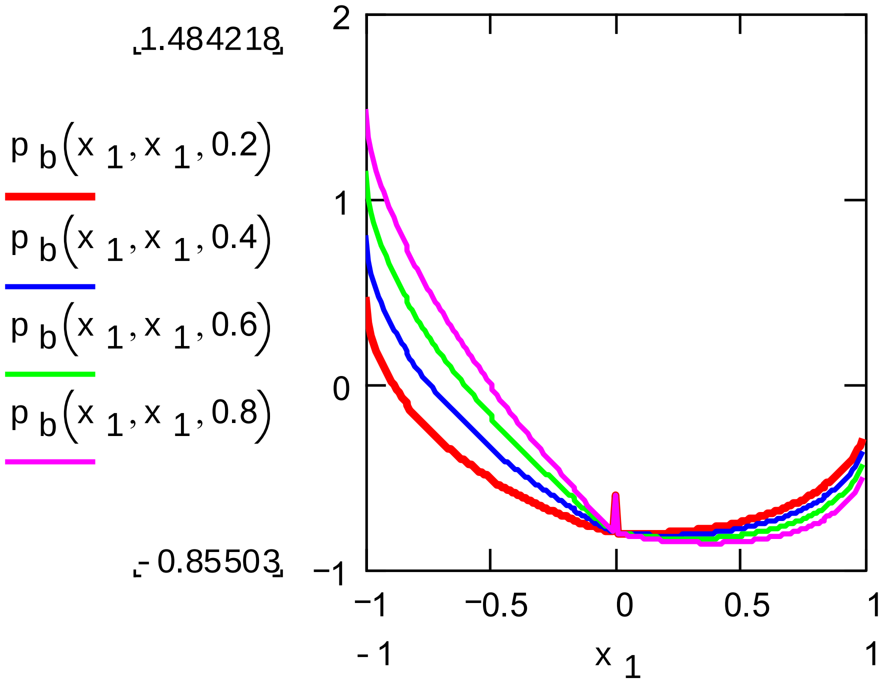

Figure 1. The dependency of the extended tension $p_b\ (x,r,\mu)$ to coefficient μ

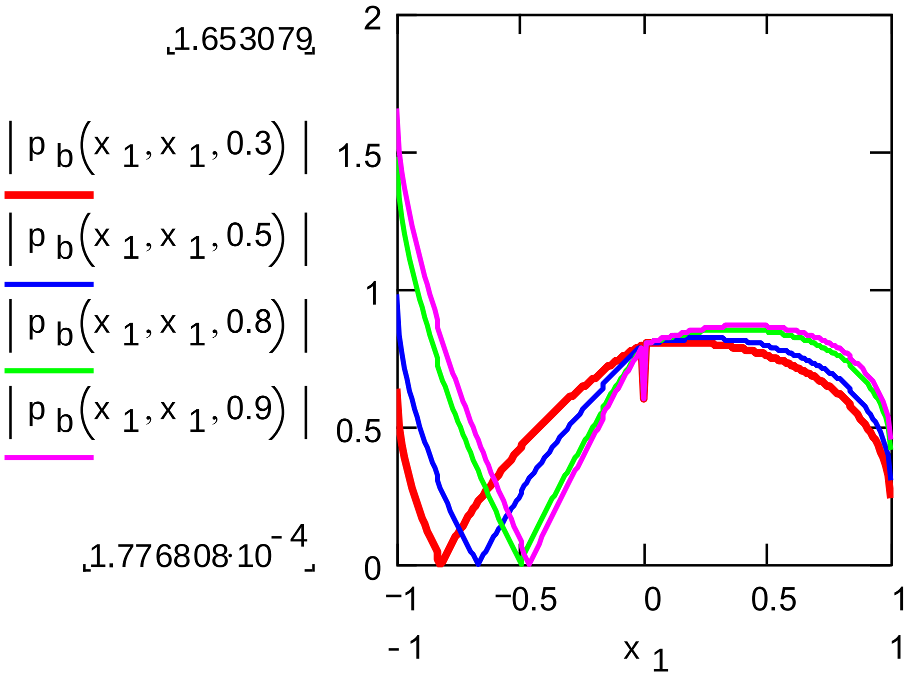

Figure 2. The dependency of the extended tension $p_b\ (x,r,\mu)$ to coefficient μ

The tension presents a minimum which moves to the center at the increase of μ.

In fig.3 the dependency of the extended tension is traced for $|x| \leq 1$, respectively for two values of r and μ. In this case it is observed that, the tilting of the curves is increased with the rise of μ , the maximum of this tension also being increased.

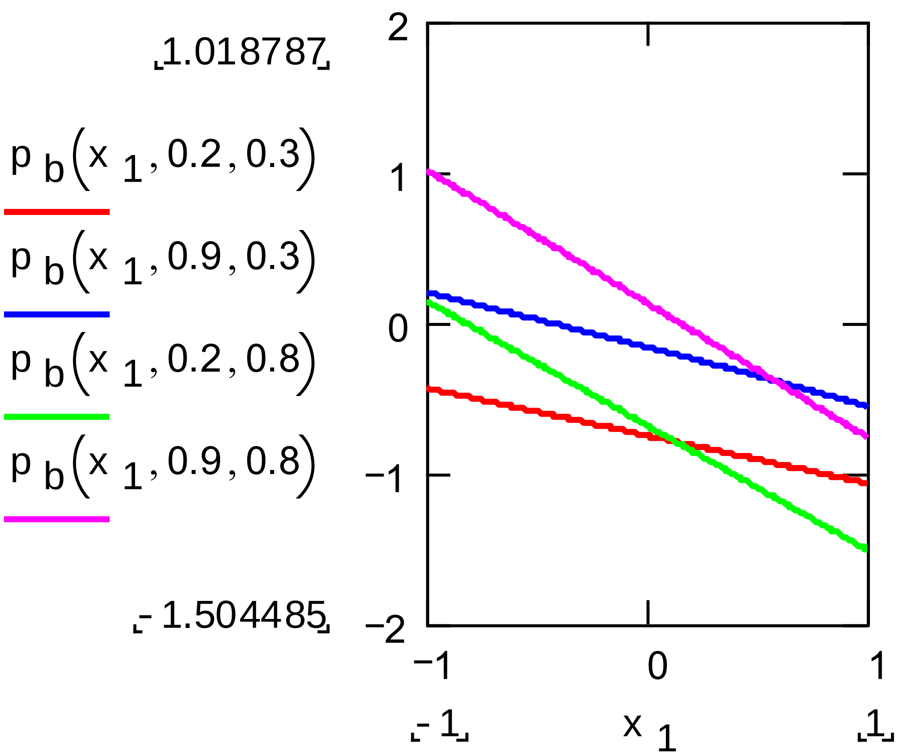

Fig.3. The dependency of the extended tension $p_b\ (x, r, \mu)$

The dependency of θ to the position of the point in the highly charged zone is presented in fig.4 and in figure 5, the dependency of the rake angle to coefficient μ is represented [11], [12].

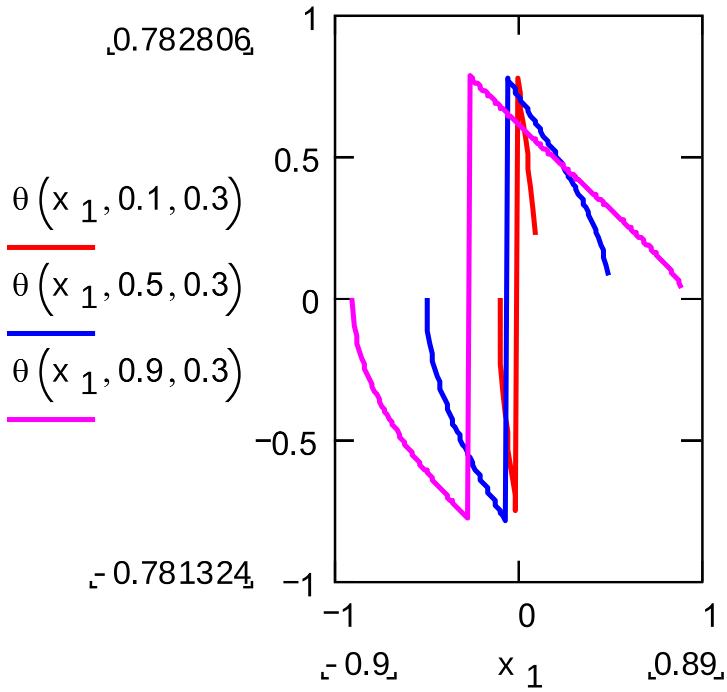

Fig.4. The dependency of the angle $\theta(x, r, \mu)$ to the position of the point

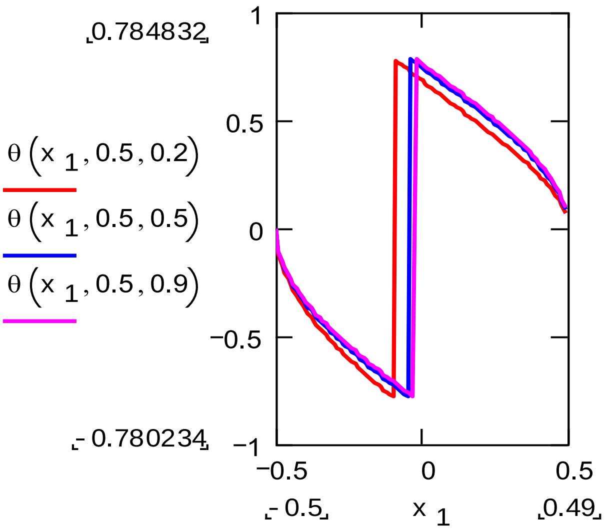

Fig.5 The dependency of the angle $\theta(x,r,\mu)$ to coefficient μ.[13]

3. CONCLUSION

Studying tension for a sphere-plane contact and representing the fatigue criterions for this contact make possible the knowledge of the state of tension at the contact level, respectively they allow designing contacts, so that it is possible to avoid the occurrence of cracks at the contact level.

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